THE SURVIVAL OF MICROÖRGANISMS IN CANNED MEAT

BY

ROBERT IRBY WISE

A.B., The University of Texas, 1937

M.S., University of Illinois, 1938

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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Commercially canned meat products containing microörganisms have been reported by previous investigators; the incidence of infected cans has varied with reports from 0 to 80 per cent. Not only heat resistant spore-forming bacteria but also members of the "non-heat resistant" non-spore-forming group of bacteria have been frequently reported present. Evidently these forms survived temperatures that ordinarily destroy non-spore-forming bacteria of the highest resistance. This striking observation presents a problem of vital importance from the standpoint of public health and the meat canning industry, since many of the supposed non-heat resistant bacteria such as staphylococci and paratyphoid (Salmonella) organisms are causal agents of food poisonings and infections.

Increased scientific knowledge of sanitation and processing has probably changed the situation so that results reported by previous investigators may not apply at present. This investigation had three objects: (1) a bacteriological examination to determine the incidence of non-sterile canned meat products, (2) a chemical examination of canned meat to correlate bacteriological findings with physical and chemical properties, and (3) a study of factors which may play important roles in survival and destruction of microörganisms in canned meats.

Among the problems studied in this investigation, a bacteriological analysis of 48 cans of merchantable meat products gave no definite evidence of the presence of microörganisms. Colonies were observed on aerobic and anaerobic plates, but since no evidence of growth appeared in corresponding enrichment broths, which received larger inoculations of meat, they were believed to be contaminants. Colonies on plates which were similar to colonies on air control plates were also believed to be contaminants. Such results lead to two conclusions: (1) Better quality canned meat products are available at the present time and (2) non-heat resistant forms reported in canned meats may have been air contaminants on agar plates.

Heat resistance studies were made in phosphate solution using spores of *Clostridium botulinum* and various concentrations of sodium nitrate, sodium nitrite, and sodium chloride. The survival

of spores of *Clostridium botulinum* in meat containing various concentrations of curing solution ingredients was also studied. Non-spore-forming microörganisms were heated in dry neutral fat and in phosphate solution to compare the thermal death times obtained.

The salts of sodium nitrate, sodium nitrite, and sodium chloride were found to exert no significant protective or destructive effects on spores of *Clostridium botulinum* when heated in phosphate solutions. There were indications of destructive effects exerted by sodium nitrate but slight enough to be considered insignificant.

In meat, sodium nitrate in amounts of 500, 1,000, and 2,000 p.p.m. gave no evidence of protection, in that inoculated spores survived equally as long in meat containing higher concentrations of nitrate as they did in meat containing no nitrate. Meat which was transferred to large amounts of liver infusion broth after heating to dilute any inhibitive effects of sodium nitrate and its decomposition products on spore germination showed no differences in results than did meat which was undiluted. This would indicate that nitrate has little or no inhibitive effects on spore germination.

Sodium nitrite exhibited a destructive effect on spores in meat when heated to 100°C.(212°F.) as evidenced by germination of heated spores in meat containing no nitrite and germination in only one tube of meat containing 100 p.p.m. sodium nitrite. All spores were destroyed in meat containing 200 and 400 p.p.m. of sodium nitrite. Dilution of the meat after heating to prevent inhibition of spore germination did not change the results. This indicates that sodium nitrite possesses a greater destructive effect on spores of *Clostridium botulinum* during heating than does sodium nitrate.

Previous investigators have stated that bacterial survival is dependent on the presence of fat in canned meat. According to this theory, bacterial cells enclosed in fat globules are not exposed to moist heat and are able to survive the effects of dry heat for much longer periods. In this investigation non-spore-forming bacteria were found to survive much longer periods in water-free neutral fat than in phosphate solution. In case of spores heated in fat containing 60 per cent moisture, which is approximately the average concentration of moisture found in canned meats, no

extraordinary survival was observed. A comparison of protein and fat in protecting microörganisms from heat in the presence of 60 per cent moisture demonstrated no differences. It can be concluded that moisture-free fat protects microörganisms from heat, but in the presence of moisture, fat exerted no marked protection of spores of *Clostridium botulinum*. The effect of fat containing various concentrations of moisture on non-spore-forming organisms was not investigated.

In this investigation the temperature of incubation of test media in thermal death time determinations was room temperature. In a comparison of thermal death time results, using 37°C, (98.6°F.) and room temperature (approximately 25 to 27°C.), longer survival of spores was indicated at the lower temperature. Germination of heated spores appeared earlier in tubes which became positive at 37°C.(98.6°F.) but tubes incubated at room temperature showed more positive tubes over a longer period of time.

A review of early investigations of canned meat products, theories of bacterial destruction, and factors important in destruction and survival of microörganisms during heating is presented.

VITA

The author was born May 19, 1915, in Barstow, Texas. He attended elementary and secondary schools in Ben Arnold, Texas, and was graduated from C. H. Yoe High School of Cameron, Texas, in 1932. The degree of Bachelor of Arts was received from the University of Texas in 1937 and the Master of Science degree from the University of Illinois in 1938. From September, 1938, to September, 1939, he was a research assistant in the Division of Animal Genetics in the College of Agriculture and the Agricultural Experiment Station at the University of Illinois. From September, 1939, to February, 1940, he was a teaching assistant in Bacteriology; from February, 1940, to June, 1940, a research assistant in Home Economics; from June, 1940, to June, 1942, a teaching assistant in Bacteriology at the University of Illinois. He is a member of Sigma Xi, Phi Sigma, and the Society of Illinois Bacteriologists.

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